



Payload Operations Integration Working  
Group (POIWG)  
April 27, 2017

**Human Research Program  
(HRP)**

Susan Torney

# HRP Overview – Increments 51/52 and 53/54





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## **AGENDA**

- HRP Inc 51/52 and Inc 53/54
  - Experiments
  - Other activities
  - Watch Items and Operational Changes
- New “HRF Centrifuge”
- New experiments for later Increments



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# NASA's Human Research Program (HRP) on ISS

*Conducting research for safe, productive human space travel and for astronauts to remain healthy during and after extended space travel. <http://www.nasa.gov/hrp>*



- ISS Research
  - Crew gives **Informed Consent** to participate in HRP research
  - Most studies have in-flight sessions with **Baseline Data Collection (BDC)** testing before and after the mission.
  - Some studies only have pre-flight and post-flight BDC (e.g., Field Test).
- **ISS Medical Projects (ISSMP)** Element of HRP implements the studies.
- Operate the **Human Research Facility (HRF)** in Columbus module and portable experiment hardware.
- Conduct operations (including ultrasound remote guidance) from the **Telescience Support Center (TSC)** at Johnson Space Center.



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## HRP – Ongoing Experiments

### In-Flight Experiments

- Biochemical Profile
- Body Measures
- Cardio Ox
- Dose Tracker
- Fine Motor Skills
- Fluid Shifts
- Functional Immune
- Habitability
- Lighting Effects
- NeuroMapping
- Repository
- Sprint (Active)

### Previous Increments

37/38 – 49/50  
37/38 – 49/50  
37/38 – 49/50  
45/46 – 49/50  
43/44 – 49/50  
43/44 – 49/50  
49/50  
43/44 – 49/50  
49/50  
41/42 – 49/50  
16 – 49/50  
27/28 – 47/48

### Pre/Post Only Experiments

- Field Test
- Intervertebral Disc Damage (IVD)
- Telomeres

### Previous Increments

43/44 – 49/50  
33/34 – 49/50  
43/44 – 49/50

### Non-Subject Experiment

- Medical Consumables Tracking (MCT)

### Previous Increments

49/50



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## HRP In-Flight Experiments

Experiment (In-Flight)	During Inc 51/52	During Inc 53/54
Biochem Profile	✓	✓
Body Measures	final sessions	
Cardio Ox	final sessions	
Dose Tracker	final sessions	
Fine Motor Skills (last HRP iPad study)	✓	final sessions
Fluid Shifts	final sessions	
Functional Immune	✓	✓
Habitability	final sessions	
Lighting Effects	✓	✓
NeuroMapping	✓	✓
Repository	✓	✓
Sprint (Active)	final sessions	

- Inc 51/52 includes extended crewmember (no additional experiments due to the extension)
- Inc 53/54 includes 2<sup>nd</sup> 52S USOS crewmember.



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## Pre/Post HRP Experiments in Inc 51/52 - 53/54 timeframe

### Experiment (Pre/Post)

Field Test \*

Intervertebral Disc Damage (IVD)

One-Carbon Expansion  
(new; questionnaire and blood)

Telomeres (final sessions in Inc 51/52)

*\* HRP/ISSMP does not track recruitment or completion  
of Russian Field Test Subjects.*

## Non-Subject HRP Experiment

### Non-Subject Experiment

Medical Consumables Tracking (MCT)

MCT RFID system was installed in CHeCS Rack during Inc 49/50.  
HRP support ends in Inc 51/52.



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## **HRP Use of Other Organizations' HW**

➤ ***HRP relies on hardware provided and/or operated by others***

### **Med Ops HW**

- **Fluid Shifts** – OCT, OCT Laptop, & Tonometer

### **Russian HW**

- **Fluid Shifts** – Operations in Service Module (power/data/video)
  - Chibis Lower Body Negative Pressure System
  - GAMMA medical monitoring system
  - Power Distribution Unit (PDU) and cables

### **Other Specialized NASA HW** (in addition to SSCs, etc.)

- **Fluid Shifts** – NASA Inverter and power cables
- **Dose Tracker, Fine Motor Skills & Habitability** – iPad 3

### **ESA HW**

- **Fluid Shifts & Cardio Ox** – CDL HLTA BP device
- **NeuroMapping** – Game Pad
- **Sprint** – Portable Pulmonary Function System (PPFS)





## HRP Support to Others

- ***BDC and ICB coordination for IP Research***
- ***HRP equipment and various services***



### CSA

- **Marrow** – Uses centrifuge and blood draw consumables.
- **Vascular Echo** – Uses centrifuge and blood draw consumables. Ultrasound 2 is a backup to ESA's ECHO ultrasound.

### ESA

- **Energy** – Uses Pulmonary Function System (PFS)
- **Airway Monitoring** – Uses PFS PuFF Calibration Syringe
- **Sarcolab-3 (with MARES)** – Uses Ultrasound 2 and PEMS 2

**Rodent Research** – Some Rodent Research missions use centrifuge

**Med Ops** – Uses Ultrasound 2 for Ocular Scans at FD30, FD90, and R-30

**CASIS** – Uses Lighting Effects Light Meter for Petri Plants - 2

- Ground Support Team support in TSC for Microbial Monitoring System (MMS), MED-2 exercise device, and Med Ops Max CEVIS.





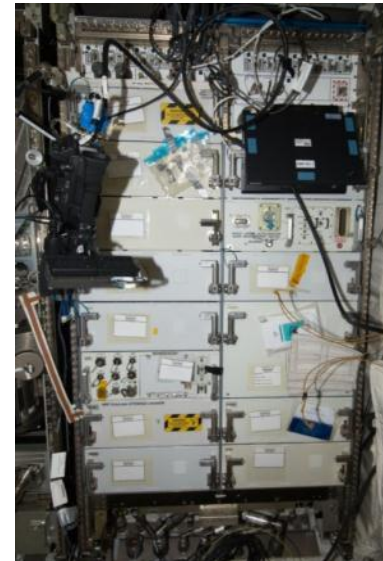
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## **HRP Facility Activities in Inc 51/52 and/or 53/54**

- HRF Supply Kit Inventory & Resupply
- Ultrasound 2 configuration management
- PFS (GDS/PFS gauge photos, PUFF syringe maintenance, relief valve checkout, SW update)
- SLAMMD control/calibration run
- iPad SSL Renewal for Fine Motor Skills
- New HRF PC software installation
- IPEHG installation in HRF Rack 1
- HRF Rack reconfiguration and new HRF centrifuge installation and checkout





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## **Ambient Blood Sample Returns**

- **Functional Immune ambient blood samples**
  - Expected on all Soyuz returns for several years
  - 48 Hour ambient return requirement from blood draw to hands of Principal Investigator (PI)
    - Achievable on normal USOS crew direct return to Houston.
    - In the event of a problem with the NASA plane, we understand contingency return will be best effort.
    - Returns without a USOS crew will be worked on a case-by-case basis
  - Blood draw occurs as close to hatch closure as allowable

Note: The Functional Immune saliva “Dry Book” will be tucked into the return pouch for ambient return with the blood samples



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## HRP Watch Items in Inc 51/52 and 53/54

- Critical timing for certain experiments
  - Fluid Shifts Dilution Measures and Chibis Ops have specific timing requirements. Multiple concurrent subjects.
  - Functional Immune dry book saliva has specific sampling times
  - One of two Lighting Effects 2-week sessions occurs over a planned sleep shift
- IPEHG
  - IPEHG is onboard ISS
  - Cables on OA-7
  - Operations Products are in work
- Blood Volume Limits
  - HRP and IP studies with blood draws
  - Requires careful management
    - ***Timeline changes affect blood volume calculations and could impact science***



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## **HRP Operational Changes on the Horizon**

- Remote Desktop Protocol (RDP) for HRF PCs
  - Ground support team will be able to access HRF PCs. Will save crew time.
- IPEHG (HRF Rack 1)
  - Will dramatically increase downlink speed
  - Will decrease ground support team on-console time for large downlinks like Ultrasound data
- Uplink of entire HRF PC loads with Ku Forward
  - Eliminates need to send the SW on physical media. Will save crew time.
  - We already uplink and install patches.
- Trashing some old HRF hardware
  - Ambulatory Data Acquisition System (ADAS) is gone
  - Considering the future of Continuous Blood Pressure Device (CBPD) and Holter Monitor 2 blood pressure device
- No more iPad apps for HRP research after Inc 53/54
  - Fine Motor Skills needs iPad 3 until finished
- New “HRF Centrifuge” in Inc 53/54



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## **New “HRF Centrifuge”**

- HRP decided it was prudent to fly a new centrifuge since the existing one has been onboard the ISS for many years.
  - Stakeholders had the opportunity to make inputs regarding features
- Plan:
  - Launch in Inc 53/54
  - Install in HRF Rack 2: COL1A4\_D1/E1
    - HRF Supply Kit Purple moves to SLAMMD stowage drawer location
    - That moves to long term stowage location (checkout every 2 years)
  - Initial checkout to verify HW functionality
  - Use to spin blood samples from a FD30 or FD120 Biochem Profile / Repository session to evaluate in-flight separation.
  - Take photos of the blood tubes prior to MELFI insertion for evaluation.
  - Use new “HRF Centrifuge”
    - No plan to remove the existing centrifuge at this time

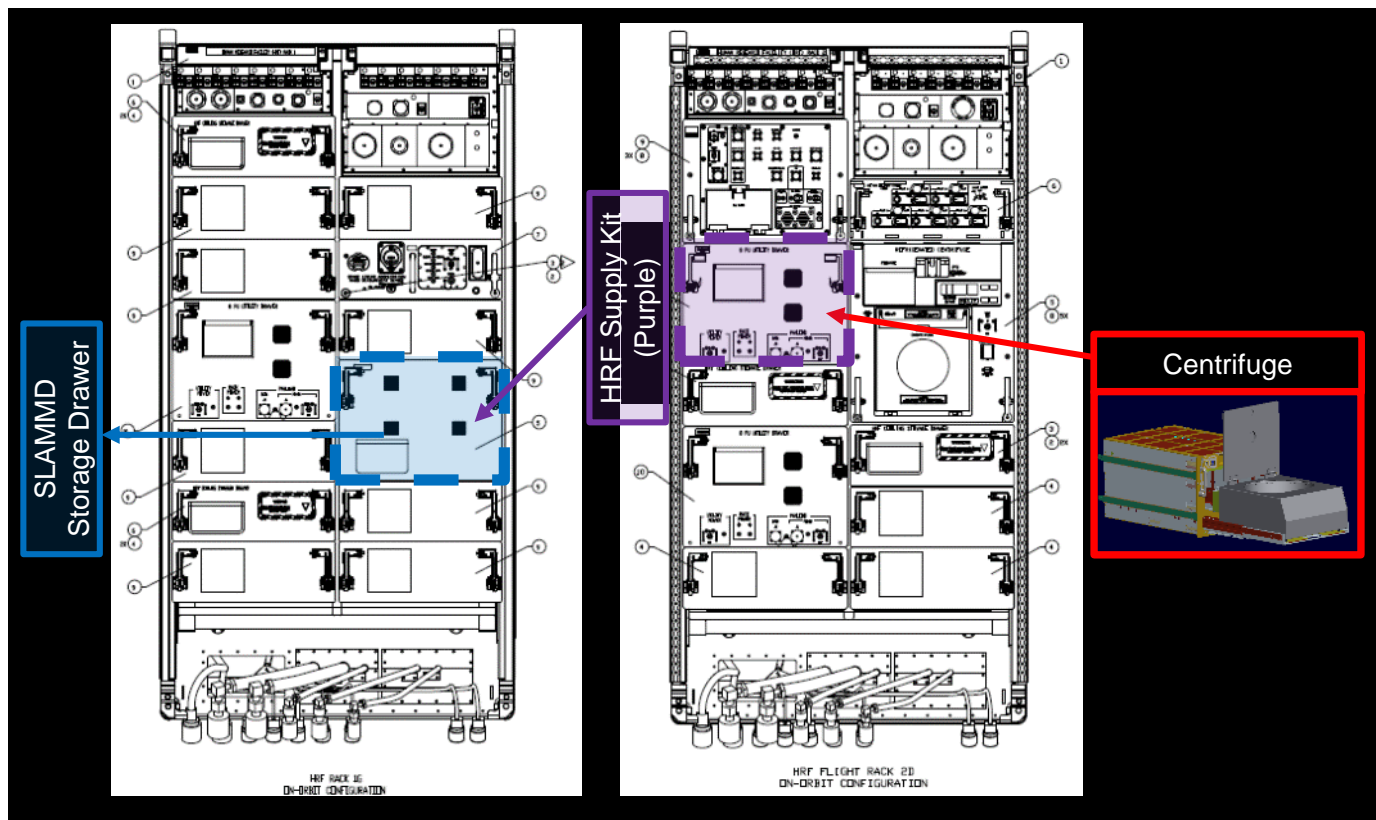


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# “HRF Centrifuge” Installation Location



HRF Rack 1

HRF Rack 2





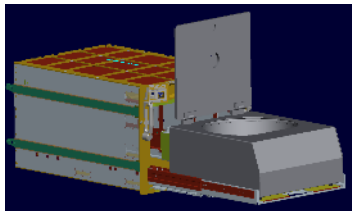
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## HRF Centrifuge Vs. Refrigerated Centrifuge (RC)

HRF Centrifuge (New)	Refrigerated Centrifuge (RC) (Existing)
8PU drawer housing	12PU drawer housing
Holds 24 blood tubes <sup>o</sup>	Holds 6 or 18 blood tubes*
No rotor or adapter changes for HRF blood draws	Multiple rotors/adapters for different tube types
Swing-bucket rotor	Fixed angle rotor
Touch-Screen Interface	Button interface
Protocol-Specific Imbalance Thresholds	Global imbalance setting



<sup>o</sup>Up to 12 double-gel tubes and 12 single-gel tubes  
*Approved for Public Release; Distribution is Unlimited*

\*Up to 6 double-gel tubes or 18 single-gel tubes





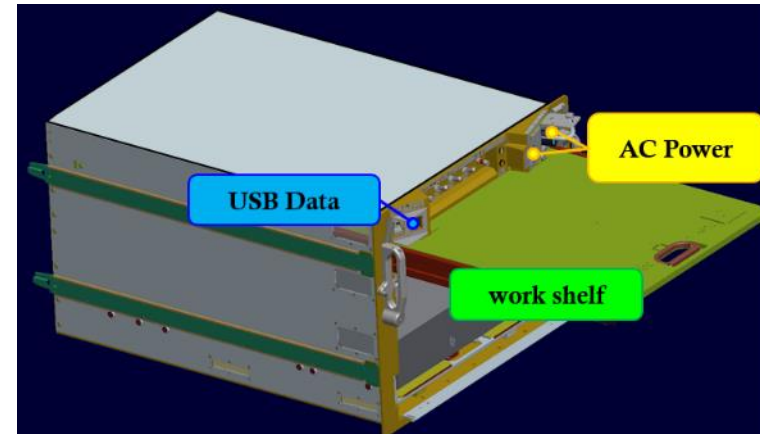
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## New “HRF Centrifuge” – More Advantages

- More operational advantages:
  - Swing-out rotors (“Swing bucket”) typically separate blood better than fixed angle rotors.
  - More health & status data to ground; ground can command centrifuge
  - Modular design facilitates on-orbit repair
  - Easier for crew to use
    - Crew trained for one centrifuge only
  - “HRF Centrifuge” payload drawer offers additional functionality:
- Deployable work shelf (15.7” extension) w/Velcro pads
- 120V AC power via standard 3-prong GFCI outlet
- USB data over Ethernet connectivity to HRF PC





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## Experiments that will use either Centrifuge

HRP	IP
Biochem Profile (Ongoing)	Marrow (Ongoing)
Repository (Ongoing)	Vascular Echo (Ongoing)
Rx Metabolism (NET Inc 55/56)	Mouse Habitat Unit 2 (MHU2) (Inc 53/54) *
Other future HRP experiments	Cell-Free Epigenome (NET Inc 53/54) *
	Medical Proteomics (NET Inc 53/54) *
Rodent Research	CASIS
Rodent Research (tied to SpaceX)	ADSEP ( <u>A</u> dvanced <u>S</u> pace <u>E</u> xperiment <u>P</u> rocessor) *

\*Pending centrifuge agreement



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## **New Approved HRP Experiments as of 4/12/2017 (Inc 55/56 & later)**

### In-Flight

- Rx Metabolism (29 hr)
- Behavioral Core Measures (~16 hrs)
- Team Task Switching (3 hr)

### Pre-Post Only

- Vertebral Strength
  - QCT and MRI sessions



**More experiments are coming...**



## **Rx Metabolism**

- This study will determine the likelihood of unexpected medication action in a spaceflight environment in preparation for exploration missions where a speedy return to Earth is not possible. It evaluates how physiological changes due to the spaceflight environment (microgravity, radiation, closed environment, stress) affect
  - Pharmacokinetics (PK) - How the body absorbs, distributes, metabolizes and excretes administered medications.
  - Pharmacodynamics (PD) - The reaction of receptors or signaling systems that are the targets of medication action.
- **In-flight: 2 sessions**
  - Pill Ingestion (active or control)
  - Timed blood draws throughout the day using intravenous (IV) blood catheter
  - Electroencephalography (EEG)
  - Cognition tests (used in Lighting Effects)
  - Actiwatch and Sleep Logs (both used in Lighting Effects)
  - Medication logging (using DCT, not Dose Tracker)



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## **Rx Metabolism - continued**

- New in-flight hardware:
  - EEG system (includes software), IV blood catheter kit, pill packages
- Crew training:
  - Biological Sampling, Regular Phlebotomy, Advanced Phlebotomy (for IV catheter), EEG class



## Behavioral Core Measures

- The primary goal is to determine if the set of complementary tests proposed is capable of acting as a functional and unobtrusive measurement of behavioral health and is feasible in a spaceflight environment.
- **In-flight:**
  - Questionnaires (use DCT)
  - Actiwatch (used in Lighting Effects)
  - Cognition tests (used in Lighting Effects)
  - Journal entries (used in previous Journals study)
  - ISS ROBoT simulator sessions (requires SW update)  
(Routinely used onboard ISS; managed & trained by others)
- No new in-flight hardware
- Crew training:
  - One integrated session (focused on Journals)



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## **Team Task Switching**

- This study uses the closest analog to the environment faced by future Mars-bound crews - the ISS - to better understand the cognitive and interpersonal challenges presented by frequent task switching and develop interventions that will enable crewmembers to more successfully navigate these challenges.
- **In-flight:** Questionnaires (use DCT)
- No in-flight hardware
- No crew training





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## More Information about HRP Research Experiments

Public research site for ISS experiments:

[https://www.nasa.gov/mission\\_pages/station/research/experiments\\_category](https://www.nasa.gov/mission_pages/station/research/experiments_category)

Space Station Research Explorer App

- Google Play:  
<https://play.google.com/store/apps/details?id=gov.nasa.jsc.igoal.ISSResearchExplorer&hl=en>
- iTunes:  
<https://itunes.apple.com/us/app/space-station-research-explorer/id934070569?mt=8>



HRP Website: <http://www.nasa.gov/hrp>



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## HRP Points of Contact

	<u>Increment 51/52</u>	<u>Increment 53/54</u>
Strategic Operations Leads	William Therrien (51) Beth Kosobud (52)	Susan Hanley (53) Logan Godfrey (54)
HRP Increment Leads	Marc Perry	Gina Miller
HRP Increment Managers	Rochelle Brown	Susan Torney